Claims

What is claimed is:

1. A system for detecting one or more shorted rotor turns in a field winding of an electric generator, comprising:

an electrical tap for measuring a first voltage drop V_{f1} and a subsequent voltage drop V_{f2} across said field winding;

an electrical shunt for measuring a first current I_{f1} and a subsequent current I_{f2} entering said field winding;

an impedance-measuring circuit for determining a reference inductance L_{REF} based on V_{f1} and I_{f1} and for determining a subsequent inductance L based on V_{f2} and I_{f2};

a memory circuit for storing L_{REF}; and

a data processing system for comparing L_{REF} to said subsequent inductance L to determine whether L_{REF} and said subsequent inductance L differ by more than a predetermined amount and for providing an alarm to indicate the presence of said one or more shorted rotor turns when L_{REF} and said subsequent inductance L differ by more than said predetermined amount.

2. The system of claim 1 wherein said impedance-measuring circuit comprises circuitry for isolating harmonic components V_0 and I_0 and an

associated harmonic frequency ω_0 using Fourier analysis and for determining L_{REF} and L via a formula $L = V_o / (\omega_0 * I_o)$.

3. The system of claim 1 wherein said impedance-measuring circuit comprises an inductance-measuring bridge.

4. The system of claim 1 wherein said impedance-measuring circuit is located onboard a spinning rotor of said electrical generator.

5. The system of claim 4 further including a telemetry circuit for transmitting data from said impedance-measuring circuit to a remote location.

6. A method for detecting one or more rotor turn shorts in a field winding of an electric generator, comprising the steps of:

taking a first measurement of a voltage V_{f1} across said field winding;

taking a first measurement of a current I_{f1} entering said field winding;

analyzing said first measurement V_{f1} and I_{f1} to isolate a harmonic component V_{o1} of V_{f1} and a harmonic component I_{o1} of I_{f1} and an associated harmonic frequency ω_{01};

calculating a reference inductance L_{REF} based on said first measurements;

taking a subsequent measurement of a voltage V_{f2} across said field winding;

taking a subsequent measurement of a current I_{f2} entering said field winding;

analyzing said subsequent measurement V_{f2} and I_{f2} to isolate a harmonic component V_{o2} of V_{f2} and a harmonic component I_{o2} of I_{f2} and an associated harmonic frequency ω_{02};

calculating a subsequent inductance L based on said subsequent measurements;

comparing said reference inductance L_{REF} to said subsequent inductance L to determine whether said reference inductance L_{REF} and said subsequent inductance L differ by more than a predetermined amount; and

providing an alarm indication if said reference inductance L_{REF} and said subsequent inductance L differ by more than said predetermined amount.

7. The method of claim 6 wherein said predetermined amount is a difference between L_{REF} and L of about 5%.

8. The method of claim 6 wherein said harmonic component is a fundamental harmonic component.

9. The method of claim 6 further comprising the step of transmitting said alarm via telemetry to a remote location.

10 The method of claim 6 wherein said step of calculating a reference inductance L_{REF} and said step of calculating a subsequent inductance L comprises using a formula $L_{REF} = V_{o1} / (\omega_{01} * I_{o1})$ and $L = V_{o2} / (\omega_{02} * I_{o2})$, respectively.

11. A method of detecting a shorted rotor turn in a field winding of an electric generator, comprising the steps of:

determining a reference inductance L_{REF} for said field winding at an initial time;

determining a second inductance L for said field winding at a time subsequent to said initial time;

comparing said reference inductance L_{REF} to said second inductance L to determine whether said reference inductance L_{REF} and said second inductance L differ by more than a predetermined amount; and

providing an alarm if said reference inductance L_{REF} and said second inductance L differ by more than said predetermined amount.

12. The method of claim 11 wherein said predetermined amount is a difference between L_{REF} and L of about 5%.

13. The method of claim 11 further comprising the step of transmitting said alarm via telemetry to a remote location.

14. The method of claim 11 wherein said step of calculating a reference inductance L_{REF} and said step of calculating a second inductance L includes isolating harmonic components V_0 and I_0 with a harmonic frequency ω_0 and using the formula $L = V_o / (\omega_0 * I_o)$.

15. The method of claim 14 wherein said harmonic component is a fundamental harmonic component.

16. The method of claim 11 wherein said step of calculating a reference inductance L_{REF} and said step of calculating a second inductance L includes obtaining an indication of L_{REF} and L from an inductance measurement bridge.

17. The method of claim 11 wherein said step of determining a reference inductance L_{REF} and said step of determining a second inductance L comprises taking measurements from said field winding while said electrical generator is in operation.